REMARKS

Claims 9-18 are pending in the application.

Claims 9-18 are rejected under 35 U.S.C. §103(a) as being unpatentable over Yoshimura et al. (U.S. Pat. No. 6,706,546) in view of Huber et al. (US 2003/0035613).

Claim 9 has been amended to more clearly define the subject matter applicants regard as the invention. More specifically, the multilayer printed circuit board recited in amended claim 9 includes "a plurality of optical layers" and "a plurality of electrically insulating layers" as most clearly shown in FIGS. 2 & 3 of the instant application. Amended claim 9 also recites that "at least two of the plurality of electrically insulting layers are separated by at least one of the plurality of optical layers", as most clearly shown in FIG. 3. In this aspect, the multilayer printed circuit board may include alternating layers of optical layers and electrically insulating layers that are contiguous or abut one another. This feature is advantageous because it allows for complex electrical and optical circuits to be integrated on one multilayer printed circuit board.

Claims 9-18 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Yoshimura et al. in view of Huber et al. Notwithstanding the amendments to claim 9, this rejection is respectfully traversed because there is no teaching, motivation or suggestion of a motivation to combine these references to arrive at the invention as claimed in amended claim 9 and those claims depending there from. Applicants respectfully submit that a <u>prima facie</u> case of obviousness has not been established for modifying the device of Yoshimura et al to have a MEMS device as taught by Huber et al.

In this regard, Huber et al. discloses 2-dimensional and 3-dimensional MEMS optical components or devices in general terms highlighting their disadvantages and underscoring that they are not well suited for IP routing applications (US 2003/0035613 A1 [0003]). Huber et al. goes on to compare and contrast solid waveguides and hollow waveguides emphasizing the advantages of hollow waveguides used for optical switching systems that can carry high energy signals and reduce losses (US 2003/0035613 A1 [0010]), which is the focus of this disclosure.

The invention of Huber et al. discloses a <u>hollow</u> waveguide optical switch, and <u>hollow</u> waveguide-based switch architectures for optical communications. The optical switch device

includes a first hollow waveguide, having a cross section defined by a first core surrounded by a first enveloping wall having a first opening, and a second hollow waveguide of similar structure. The first and second hollow waveguides are positioned in partially overlapping relationship defined by a common overlap of their respective openings. First and second light guiding levers are positioned substantially in the plane of the first and second openings, respectively. These levers are operative in response to actuating signals to assume first and second switching positions (US 2003/0035613 A1 [0012]).

FIG. 2 of Huber et al. illustrates an exemplary arrangement of a first hollow waveguide 200 with an opening 202 in its top wall 204. This opening will overlap a similar opening 206 on a bottom wall 208 of a second hollow waveguide 210. Each waveguide is embedded in a substrate, preferably a wafer made of a material such as silicon, silica, GaAs, or any other substrate material commonly used in microelectronics and integrated optics technologies. The two hollow waveguides 200, 210 contained within respective wafers are juxtaposed and bonded together "face to face" so their respective openings overlap (US 2003/0035613 A1 [0030]).

The embodiments of Huber et al. require that the overlapping openings in two juxtaposed hollow waveguides forming a crossbar are substantially identical. In this respect, each opening must have substantially identical dimensions and the angular relationship between respective hollow waveguides must be maintained within certain limits to achieve low losses (US 2003/0035613 A1 [0033]). Parallel levers 502 at least partially cover respective openings and lie in an x-y plane substantially parallel to the top and bottom hollow waveguide walls. Extensive design considerations are disclosed in Huber et al. with respect to the functionality of levers 502 within the openings of respective hollow waveguides to achieve performance specifications. Notwithstanding this disclosure with respect to levers 502 and their design, there is no teaching, suggestion or suggestion of a motivation to combine the teachings of Huber et al. with Yoshimura et al. to modify the device of Yoshimura et al. to have a MEMS device as taught by Huber et al., to arrive at the invention as claimed herein by applicants.

More specifically, Huber et al. teaches the use of levers 502 within overlapping hollow waveguides having a common opening through which optical signals may be redirected by switching levers 502. Huber et al. does not teach or suggest anything with respect to coupling or

decoupling optical signals within solid waveguides, or with respect to an add-drop multiplexer integrated within a multilayer printed circuit board as claimed herein by applicants.

The Examiner previously asserted that Yoshimura et al. discloses an optical device with nearly all the limitations set forth in the claims, except it does not explicitly teach the use of a micro-electrical-mechanical system. The Examiner further asserts that it would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify the device of Yoshimura et al. to have a MEMS device as taught in Huber et al. The basis for this assertion is that such MEMS "is considered advantageous and desirable in the art because it provides an optical beam routing means capable of having more than one optical path, resulting in a more robust optical communications device." Applicants respectfully submit that this basis is merely conclusory and that the Examiner has not adequately explained why the teachings of Huber et al. and Yoshimura et al. would have suggested the invention as claimed herein to one having ordinary skill in the art. Concluding that these references could be combined to achieve "a more robust communications device" does not provide a sufficient factual basis for combining the references to arrive at the claimed invention. Thus, a prima facie case of obviousness has not been established with respect to the combination of Huber et al. and Yoshimura et al.

In this regard, amended claim 9 recites, among other aspects, that the components of the add-drop multiplexer ".... are formed within at least one of a plurality of optical layers integrated within a multilayer printed circuit board comprising a plurality of electrically insulating layers wherein at least two of the plurality of electrically insulating layers are separated by at least one of the plurality of optical layers, ...". FIG. 3 of the instant application illustrates an embodiment of the invention having alternating, contiguous layers of a plurality of optical layers and a plurality of electrically insulating layers. Further, each layer, whether an electrical insulating layer or an optical layer, may contain electrical and optical connections. There may also be a plurality of layers of one type, which in turn lie above a plurality of layers of the other type (US 2006/0104562 A1 [0013]). Neither Huber et.al. nor Yoshimura et al. teach, disclose or otherwise suggest to one of ordinary skill in the art to modify the device of Yoshimura et al. to arrive at the invention as claimed in amended claim 19.

With respect to applicants' claimed invention directed to a multilayer printed circuit board, Huber et al. does not specifically address this type of medium but instead teaches that

each hollow waveguide is embedded within a substrate, preferably a wafer made of a material such as silicon, silica, GaAs, or any other substrate material commonly used in microelectronics and integrated optic technologies. Any two such wafer structures may be bonded together so that respective openings of two hollow waveguides define a common opening in a contact plane (US 2003/0035613 A1 [0030]). Consequently, any two contiguous layers must contain a hollow waveguide whereas the instant invention may contain alternating layers of electrically insulating layers and optical layers forming a multilayer printed circuit board. This aspect of Huber et al. teaches away from applicants' invention because the device of Huber et al. must have contiguous layers of hollow waveguides in order for levers 502 to redirect an optical signal from one layer to another. Thus, the teachings of Huber et al. would not lead one of ordinary skill in the art to arrive at the invention as claimed herein by applicants.

With regard to Yoshimura et al., it teaches a wide range of embodiments of electronic circuit assemblies, none of which include or suggest an add-drop multiplexer within a multilayer printed circuit board as claimed herein by applicants. FIG. 143 of Yoshimura et al. illustrates an exemplary embodiment of a stand alone OE Printed Circuit Board to which a stand-alone OE Multi Chip Module and stand-alone integrated circuit chips are affixed. Also, FIGS. 201 and 202 illustrate that a substrate 1400 may be affixed to a printed circuit board 4000 by any known procedure such as solder joining. Thus, Yoshimura et al. teaches that embodiments of electronic circuit assemblies may be attached to printed circuit boards for optical and electrical communication but there is no teaching, suggestion or motivation that would lead one skilled in the art to fabricate an add-drop multiplexer within a multilayer printed circuit board containing integrated optical layers and electrically insulating layers as claimed in amended claim 9.

The Examiner cited column 2, line 24 through column 3, line 12 as disclosing a multilayer electro-optic circuit board. Applicants respectfully submit that this cited section does not disclose or teach a multilayer printed circuit board as claimed in amended claim 9. In fact, this section teaches away for integrating a plurality of optical layers and a plurality of electrically insulating layers thereby forming a multilayer printed circuit board. More specifically, column 2, line 53 through column 3, line 9 discloses that OE devices can be embedded into waveguide layers by using wafer processing techniques and that these devices may be integrated with optical waveguides in ultra thin polymer layers. These OE layers may then be stacked on top of

one another by joining them together, such as by lamination or by a build-up fabrication process. These layers may then be overlaid upon the surface of a conventional electrical substrate. Thus, a discrete group of optical waveguide layers are overlaid on top of a conventional electrical substrate, which teaches away from a multilayer printed circuit board having at least two of the plurality of electrically insulating layers separated by at least one of the plurality of optical layers as claimed in amended claim 9.

New claim 20 has been added to more clearly define the subject matter applicants regard as the invention, the principle support for which is found in paragraph [0034] of US 2006/0104562 A1. New claim 20 recites, among other aspects, that the micro-electrical-mechanical system comprises an add-drop device that receives a first subsignal from the demultiplexer. The add-drop device generating a second subsignal, which may be a coupled or decoupled signal that includes added or dropped channels depending on the switching status of the add-drop device (US 2006/0104562 A1 [0031] and [0034].

As pointed out by the Examiner, Yoshimura et al. discloses the use of demultiplexers and multiplexers for various purposes. However, neither Yoshimura et al. nor Huber et al. disclose, teach or suggest a micro-electrical-mechanical system comprising an add-drop device as claimed in new claim 20.

Finally, with regard to combining the teachings of Huber et al. with those of Yoshimura et al., it would be a physical impossibility to modify the device of Yoshimura et al. with the switching levers 502 taught by Huber et al. This is because the waveguides of Yoshimura et al. are solid waveguides incapable of such modification. Also, the hollow waveguides of Huber et al. must be maintained within specific angular relationships to prevent losses of the optical signal. The optical waveguides of Yoshimura et al. do not satisfy these relationships and would have to be drastically altered to bring them into compliance with using levers 502. Such modifications would defeat the optical switching functionality of the Yoshimura et al. device, which rely extensively on mirrors.

For example, FIGS. 155, 156-1 and 156-2 illustrate representative embodiments of the device of Yoshimura et al., which have optical routing patterns that include 90° bends. A mirror such as a semi-transparent mirror may be used for directing a light beam at these right angles as shown in the figures. One skilled in the art would find no motivation to modify embodiments of

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Yoshimura et al. with the levers 502, or other MEMS suggested in Huber et al., to arrive at the invention as claimed in amended claim 19.

In view of the foregoing amendment and remarks, applicants respectfully request reconsideration of this application and submit that claims 9-18 and 20 are in condition for allowance. Notice to that effect is respectfully requested.

Conclusion

The commissioner is hereby authorized to charge any appropriate fees due in connection with this paper, including the fees specified in 37 C.F.R. §§ 1.16 (c), 1.17(a)(1) and 1.20(d), or credit any overpayments to Deposit Account No. 19-2179.

Respectfully submitted,

Dated: 1/17/07

By: [signature]

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